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U.S. Patent Application

of

ARTO SUOMI

relating to

ARRANGEMENT FOR SUPPORTING DATA EXCHANGE BETWEEN TERMINAL  
EQUIPMENT AND A MOBILE COMMUNICATION NETWORK  
VIA A MOBILE TERMINAL

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Arrangement for supporting data exchange between terminal  
equipment and a mobile communication network via a mobile  
5 terminal

#### FIELD OF THE INVENTION

The invention relates to a method for supporting a data  
10 exchange between terminal equipment and a mobile  
communication network via a mobile terminal. The  
invention relates equally to a corresponding mobile  
terminal, to a corresponding terminal equipment, to a  
corresponding system and to a corresponding software  
15 program product.

#### BACKGROUND OF THE INVENTION

It is known in the art to enable terminal equipment,  
20 which is not capable of directly accessing a mobile  
communication network itself, to access such a mobile  
communication network via a mobile terminal.

The technical specification 3GPP TS 27.060 V5.4.0 (2003-  
25 06): "Technical Specification Group Core Network; Packet  
Domain; Mobile Station (MS) supporting Packet Switched  
Services" defines for example requirements for an  
interworking between terminal equipment and a mobile  
terminal for the Packet Domain, including the protocols  
30 and signaling needed to support Packet Switched services.

When a mobile terminal tries to establish a connection to  
a mobile communication network upon a request by terminal

equipment, the setup may fail due to various reasons, for example due to insufficient network resources. Equally, an already established connection may be released from the network side prematurely due to various reasons, for  
5 example due to an error situation in the mobile communication network. The failure does not necessarily have to be in the mobile communication network itself, but may also be reported to the mobile communication network, for instance by an external network, which the  
10 mobile terminal tries to access via the mobile communication network.

When a mobile communication network rejects a request for an establishment of a connection or releases an  
15 established connection, it usually informs the mobile terminal about the respective cause of the failure. The technical specification 3GPP TS 24.008 V6.1.0 (2003-06): "Technical Specification Group Core Network; Mobile radio interface Layer 3 specification; Core network protocols;  
20 Stage 3", for instance, associates to this end GPRS specific cause values for a session management to various failure causes. A cause value which is transmitted by a mobile communication network to a mobile terminal may cause a corresponding textual error message to be  
25 displayed on a user interface of the mobile terminal.

There is no mechanism, however, to inform as well terminal equipment trying to access the mobile communication network via the mobile terminal why a  
30 requested connection is not established or why an established connection is released. This is a disadvantage, since users using their terminal equipment do usually not look in parallel at their mobile terminal.

## SUMMARY OF THE INVENTION

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The invention facilitates the establishment and maintenance of a connection between terminal equipment and a mobile communication network via a mobile terminal.

- 10 A method for supporting a data exchange between terminal equipment and a mobile communication network via a mobile terminal is proposed, which comprises at the mobile terminal receiving from the terminal equipment a request to establish a connection to the mobile communication  
15 network for exchanging data and forwarding the request to the mobile communication network. The method further comprises in case a failure occurs concerning the requested connection and an indication of a cause of the failure is received at the mobile terminal from the  
20 mobile communication network, forwarding the indication to the terminal equipment.

Moreover, a mobile terminal is proposed which comprises a transceiver enabling an exchange of signals with a mobile  
25 communication network and in addition an interface enabling an exchange of signals with other devices. The proposed mobile terminal further comprises a processing component for receiving from terminal equipment via the interface a request to establish a connection to a mobile  
30 communication network for exchanging data, for forwarding the request to a mobile communication network via the transceiver, and in case a failure occurs concerning the connection and an indication of a cause of the failure is

received from the mobile communication network, for forwarding the indication to the terminal equipment.

Moreover, terminal equipment is proposed which comprises  
5 an interface enabling an exchange of signals with other devices. The proposed terminal equipment further comprises a processing component for requesting a mobile terminal via the interface to establish a connection to a mobile communication network, for receiving from a mobile  
10 terminal an indication of a cause of a failure concerning a requested connection and for processing a received indication of a cause of a failure.

Moreover, a system is proposed which comprises the  
15 proposed mobile terminal, the proposed terminal equipment and a mobile communication network.

Finally, a software program product is proposed, in which a software code for supporting a data exchange between  
20 terminal equipment and a mobile communication network via a mobile terminal is stored. The software code realizes the following steps when running in a processing component of a mobile terminal: Receiving from a mobile communication network an indication of a cause of a  
25 failure concerning a connection which has been requested by terminal equipment via the mobile terminal and forwarding the indication to the terminal equipment.

The invention proceeds from the idea that an indication  
30 of the cause of a failure provided by a mobile communication network to a mobile terminal can be forwarded by the mobile terminal to a terminal equipment, if the failure relates to a connection between the mobile

terminal and the mobile communication network requested by the terminal equipment.

5 It is an advantage of the invention that information on the cause of a failure concerning a connection which has been requested by the terminal equipment is available as well at the terminal equipment. The terminal equipment may make use of the received information for example by displaying it to a user via a user interface of the  
10 terminal equipment or by storing it for a later evaluation.

The failure for which a cause is provided may be a failure resulting in a rejection of the request to  
15 establish a connection, i.e. the failure may occur before the connection is actually established. Alternatively, the failure for which a cause is provided may be a failure resulting while a connection is established.

20 For the connection between the terminal equipment and the mobile terminal, for instance the Point-to-Point Protocol (PPP) can be used. PPP provides a standard method for transporting multi-protocol datagrams over point-to-point links.

25 If the connection between the terminal equipment and the mobile terminal is PPP-based, the indication of a failure cause can be forwarded to the terminal equipment in particular in the data field of an Link Control Protocol  
30 (LCP) Terminate Request message described in the IETF RFC 1661 "The Point-to-Point Protocol (PPP)" by W. Simpson, (Editor), July 1994.

PPP is comprised of three main components, a method for encapsulating multi-protocol datagrams, an LCP for establishing, configuring, and testing the data-link connection and a family of Network Control Protocols (NCPs) for establishing and configuring different network-layer protocols.

The IETF RFC 1661 defines three classes of LCP packets, namely Link Configuration packets used to establish and configure a link, Link Termination packets used to terminate a link and Link Maintenance packets used to manage and debug a link. Each of these packets comprises a code field, an identifier field, a length field and a data field of zero or more octets. The format of the data field is determined by the code field, and the length of the data field is indicated in the length field. While the content of the data field is defined for Link Configuration packets and Link Maintenance packets, it may contain any data for use by the sender in the case of Link Termination packets. This data may consist of any binary value and is thus suited to comprise as well cause values provided by a mobile communication network.

The invention can be employed for example with a GPRS capable mobile terminal, but equally with any other mobile terminal which enables terminal equipment to access a mobile communication network. The invention can further be employed for any terminal equipment which is able to establish a connection to a mobile communication network via a mobile terminal, for example a PDA or a PC.

The invention can be realized in particular, though not exclusively, by a software running in the processing

component of the mobile terminal and of the terminal equipment, respectively.

Other objects and features of the present invention will  
5 become apparent from the following detailed description considered in conjunction with the accompanying drawings. It is to be understood, however, that the drawings are designed solely for purposes of illustration and not as a definition of the limits of the invention, for which  
10 reference should be made to the appended claims. It should be further understood that the drawings are not drawn to scale and that they are merely intended to conceptually illustrate the structures and procedures described herein.

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#### BRIEF DESCRIPTION OF THE FIGURES

- Fig. 1 schematically shows a system in which the invention can be implemented;
- 20 Fig. 2 is a flow chart illustrating an embodiment of the method according to the invention;
- Fig. 3 is a diagram illustrating some signaling in the embodiment of the method according to the invention; and
- 25 Fig. 4 illustrates an LPC Terminate Request message format employed in the embodiment of the method according to the invention.

#### DETAILED DESCRIPTION OF THE INVENTION

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The invention can be implemented for example in the system depicted in Figure 1. In this system, a terminal equipment 10 may access an external packet data network



20 via a mobile terminal 30 and a mobile communication network 40.

The terminal equipment 10 of the system is assumed by way  
5 of example to be a laptop computer. The laptop computer  
10 comprises an external interface 11, a display 12 as a  
user interface, a storing component 13 and a processing  
component 14. The processing component 14 is connected to  
each of the external interface 11, the display 12 and the  
10 storing component 13. The processing component 14 is  
designed specifically for realizing the invention, as  
will become apparent further below. It is to be  
understood that also the processing component 14 can be  
composed of one or of several components, that it may  
15 comprise software and/or hardware elements for the  
required processing, and that it can be connected to the  
external interface 11, the display 12 and the storing  
component 13 either directly or via further components.  
The laptop computer 10 comprises in addition various  
20 other components as known in the art, which are not shown  
in Figure 1.

The mobile terminal 30 of the system is assumed by way of  
example to be a GPRS capable mobile phone. The mobile  
25 phone 30 comprises a transceiver 31, an external  
interface 32 and a processing component 33 connected to  
both. The processing component 33 is designed  
specifically for realizing the invention, as will become  
apparent further below. It is to be understood that the  
30 processing component 33 can be composed of one or of  
several components, that it may comprise software and/or  
hardware elements for the required processing, and that  
it can be connected to the transceiver 31 and to the  
external interface 32 either directly or via further

components. The mobile phone 30 comprises in addition various other components as known in the art, which are not shown in Figure 1.

5 The mobile communication network 40 of the system is assumed by way of example to be a PLMN (Public Land Mobile Network) enabling communication in a packet switched network, e.g., GPRS. The mobile communication network 40 provides access to the external packet data  
10 network 20 in a known manner. The access to the external packet data network 20 can be used for example to request packet data for a specific service which is offered via the external packet data network 20.

15 The functioning of the system of Figure 1 will now be explained in more detail with reference to Figures 2 and 3. Figure 2 is a flow chart schematically illustrating the method according to the invention on the mobile side, i.e. on the side of the laptop computer 10 and the mobile  
20 phone 30. Figure 3 is a modified diagram from the above mentioned specification TS 27.060, which is incorporated by reference herein. The diagram of Figure 3 illustrates the signaling between the laptop computer 10, the mobile phone 30 and the mobile communication network 40 for a  
25 part of the flow chart of Figure 2. All signaling between the laptop computer 10 and the mobile phone 30 is carried out via the interfaces 11, 32, and the mobile phone 30 exchanges signals with the mobile communication network 40 via its transceiver 31.

30

When a user of the laptop computer 10 desires to access the external packet data network 20, first a PPP link has to be established between the laptop computer 10 and the

mobile phone 30, which is represented in Figure 2 by a first block 201.

5 The signaling between the laptop computer 10 and the mobile phone 30 for establishing the PPP link is shown in more detail as steps 1 to 7 in Figure 3.

10 In step 1, the processing component 14 of the laptop computer 10 sends an AT command message to the processing component 33 of the mobile phone 30 in order to set up parameters and to enter a PPP mode. The processing component 33 of the mobile phone 30 responds with an AT response message in step 2. For establishing the PPP link between the laptop computer 10 and the mobile phone 30, a  
15 PPP in the processing component 14 of the laptop computer 10 then sends an LCP Configure-Request message to the processing component 33 of the mobile phone 30 in step 3. In step 4, the processing component 33 of the mobile phone 30 returns an LCP Configure-Ack message to the  
20 processing component 14 of the laptop computer 10 to confirm that the PPP link has been established.

Further, a PPP in the processing component 33 of the mobile phone 30 sends an LCP Configure-Request message to  
25 the processing component 14 of the laptop computer 10 in step 5 to negotiate for the authentication protocol which is to be used for authenticating the laptop computer 10 towards the mobile phone 30. The processing component 14 of the laptop computer 10 returns thereupon in step 6 an  
30 LCP Configure-Ack message to the processing component 33 of the mobile phone 30 to confirm the use of the specified authentication protocol. If the negotiated authentication protocol is either CHAP (Challenge Handshake Authentication Protocol) or PAP (Password

Authentication Protocol), the laptop computer 10 authenticates itself towards the mobile phone 30 by means of this protocol in step 7.

- 5 Once the PPP link is established, a PDP (Packet Data Protocol) context has to be activated between the mobile phone 30 and the mobile communication network 40, which is represented in Figure 2 by block 202.
- 10 The signaling between the laptop computer 10, the mobile phone 30 and the mobile communication network 40 for the activation of the PDP context is shown as steps 8 to 10 in Figure 3.
- 15 In step 8, the PPP in the processing component 14 of the laptop computer 10 sends an IPCP (Internet Protocol Control Protocol) Configure-Request message to the processing component 33 of the mobile phone 30 for activating the IP protocol. The IPCP constitutes a
- 20 selected NCP (Network Control Protocol). This message comprises the request to establish a PDP context and all information on the service desired by the laptop computer, for example a PDP address for the desired service and user authentication information for the
- 25 desired service. If the mobile phone 30 is not yet PS (Packet Switched) attached to the mobile communication network 40, the processing component 33 of the mobile phone 30 initiates thereupon in step 9 a PS attach procedure with the mobile communication network 40. In
- 30 step 10, the processing component 33 of the mobile phone 30 transmits a PDP Context Activation Request message to the mobile communication network 40.

In case the external packet data network 20 or the mobile communication network 40 does not accept for some reason the request to establish a PDP context, the PPP link between the laptop computer 10 and the mobile phone 30 is released again, which is represented in Figure 2 by block 203. In accordance with the invention, the cause for the release is indicated to the laptop computer 10.

The signaling between the laptop computer 10, the mobile phone 30 and the mobile communication network 40 for the rejection of the PDP context and the release of the PPP link is shown as steps 11 and 12 in Figure 3.

In step 11, the mobile communication network 40 rejects the PDP context activation request by transmitting a PDP context Activate Reject message to the processing component 33 of the mobile phone 30. The rejection message contains an eight-bit cause value indicating the reason for the failure. The cause value and its association to a specific failure cause is taken from the above mentioned specification TS 24.008. In this specification it is proposed, for example, that a mobile communication network informs a mobile terminal that a request cannot be accepted due to insufficient resources with a cause value of 26 or that a requested service was rejected by an external packet data network because a PDP address or type could not be recognized with a cause value of 28. Similarly, other cause values are defined for various other failure causes.

In step 12, the processing component 33 of the mobile phone 30 sends an LCP Terminate Request message to the processing component 14 of the laptop computer 10 which

contains the same cause value as the PDP context Activate Reject message received by the mobile phone 30.

The structure of the employed LCP Terminate Request  
5 message is presented in figure 4.

The LCP Terminate Request message comprises a Code-field of 10 bits, an Identifier-field of 7 bits, a Length-field of 15 bits, and a Cause-field of 8 bits. The structure of  
10 the LCP Terminate Request message thus corresponds to the structure of the LCP Terminate Request message defined in the above mentioned RFC 1661, except that the Data-field is defined as Cause-field. The value in the Code-field is set to "5", as defined in the RFC 1661 for a Terminate  
15 Request message. The value in the Identifier-field is set for example to a dummy value of "0". The value in the Length-field is set to "5", since the entire message comprises 5 octets. The value in the Cause-field is set to the cause value provided by the mobile communication  
20 network 40 to the mobile phone 30.

All possible cause values are associated in the storing component 13 of the laptop computer 10 to a textual error message in accordance with the definitions in the above  
25 mentioned specification TS 24.008.

The processing component 14 of the laptop computer 10 extracts the cause value from the received LCP Terminate Request message, retrieves the associated textual error  
30 message from the storing component 13 and presents the retrieved textual error message on the display 12 to the user, as represented in Figure 2 by block 204. Further, all PPP related messages between the laptop computer 10 and the mobile phone 30 are recorded by the processing

component 14 of the laptop computer 10 in a PPP log file  
in the storing component 13. Thus, also the LCP Terminate  
Request message comprising the cause value is stored in  
the PPP log file, as represented in Figure 2 by block  
5 205.

In case the external packet data network 20 and the  
mobile communication network 40 accept the PDP context  
Activate Request represented by block 202 in Figure 2,  
the PDP context is established between the laptop  
10 30 and the mobile communication network 40, as  
represented by block 206 in Figure 2. The processing  
component 33 of the mobile phone 30 informs the laptop  
computer 10 that the IP protocol is activated by sending  
15 an IPCP Configure-Ack message to the processing component  
14 of the laptop computer 10. Now, the packet data of a  
desired service may be delivered by the external packet  
data network 20 via the mobile communication network 40  
to the mobile phone 30 using the established PDP context  
20 and further to the laptop computer 10 using the PPP link  
in a known manner. This is indicated in Figure 2 by block  
207.

When all packet data belonging to the desired service has  
25 been transmitted successfully, the PDP context and the  
PPP link are released again in a known manner. This is  
indicated in Figure 2 by block 208.

If, however, there is some failure during the  
30 transmission of the packet data, the established PDP  
context is released by the mobile communication network  
40 and the processing component 33 of the mobile phone 30  
is informed about the cause of the failure in a known  
manner with a cause value as defined in the above

mentioned specification TS 24.008. The processing component 33 of the mobile phone 30 releases thereupon as well the PPP link to the laptop computer 10 by transmitting an LCP Terminate Request message to the laptop computer 10, as indicated in Figure 2 by block 209. The LCP Terminate Request message has again the structure depicted in figure 4 and comprises in the Cause-field the cause value provided by the mobile communication network 40.

10 As in the case of an initial failure, the processing component 14 of the laptop computer 10 extracts the cause value from the received LCP Terminate Request message, retrieves an associated textual error message from the storing component 13 and presents the retrieved textual error message on the display 12 of the laptop computer 10, as represented in Figure 2 by block 210. Further, the LCP Terminate Request message comprising the cause value is stored in the PPP log file, as represented in Figure 2 by block 211.

The user of the laptop computer 10 is thus informed directly via the display 12 of the laptop computer 10 about any failure causes. This has the advantage that the user has only to keep an eye on the laptop computer 10 for being informed comprehensively and for being able to react accordingly. Based on the cause values stored in the PPP log files of the laptop computer 10, the failure reason can also be debugged at a later point of time.

30 While it has been shown, described and pointed out fundamental novel features of the invention as applied to a preferred embodiment thereof, it will be understood that various omissions and substitutions and changes in



the form and details of the devices and methods described  
may be made by those skilled in the art without departing  
from the spirit of the invention. For example, it is  
expressly intended that all combinations of those  
5 elements and/or method steps which perform substantially  
the same function in substantially the same way to  
achieve the same results are within the scope of the  
invention. Moreover, it should be recognized that  
structures and/or elements and/or method steps shown  
10 and/or described in connection with any disclosed form or  
embodiment of the invention may be incorporated in any  
other disclosed or described or suggested form or  
embodiment as a general matter of design choice. It is  
the intention, therefore, to be limited only as indicated  
15 by the scope of the claims appended hereto.